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GIANT EARLY MAN FROM JAVA AND SOUTH CHINA[1]

By Dr. FRANZ WEIDENREICH

AMERICAN MUSEUM OF NATURAL HISTORY

JAVA, which stood in the focus of anthropologists fifty years ago when Eugène Dubois first announced the find of the "missing link," *Pithecanthropus erectus,* became a cynosure again when Dr. R. von Koenigswald, of the Geological Survey of Netherlands Indies, made a series of discoveries, each later one always more important than its predecessor. It began, in 1937, with the discovery of a large fragment of a lower jaw found in the Trinil beds of Sangiran. This jaw was much more complete than the one picked up by Dubois from the Trinil beds of Kedung Brubus, in 1891, and later attributed by this author to *Pithecanthropus.* Then followed the surprising discovery, in 1938, of a skull cap—fragmentary too—but much more complete than Dubois' Trinil skull which it resembles as one egg another in general form as well as in details. This specimen proved beyond the slightest doubt that *Pithecanthropus* is morphologically not a giant gibbon, and as such intermediate between ape and man, as Dubois insisted, but a true hominid very like the Peking man, *Sinanthropus pekinensis.* In 1939, von Koenigswald's native collector picked up an upper jaw from the same site from which the skull cap of 1938 had come. This jaw, almost complete, but slightly crushed, was the second surprise. It was in all dimensions larger than any known fossil or recent human jaw; there was a fairly wide gap between the canine and the incisor; the canine was not tusk-like but showed all the peculiarities of the *Sinan-*

[1] Read before the American Ethnological Society in New York, May 9, 1944. The war and its consequences prevented Dr. R. von Koenigswald from announcing the new discoveries referred to in this paper. Since Java is cut off and neither Dr. von Koenigswald nor the Geological Survey of Netherlands Indies are approachable, I asked the Board for the Netherlands Indies, Surinam and Curaçao, which represents the government of Netherlands Indies, for an official permit to publish the material, being sure of Dr. von Koenigswald's personal consent. Mr. G. H. C. Hart, the chairman of the board, kindly approved the publication.

thropus canines; the second molar was larger than the first and the third ones and, finally, the palate was smooth and not covered with rugosities. In other words, the jaw exhibited several very distinct simian features beside its general human appearance, a combination never observed before. Some weeks later the calvaria to which the jaw belonged was recovered. Although the entire frontal part is missing the rest is impressive enough. The brain case is considerably larger than that of the two *Pithecanthropus* skulls, not because of greater capacity but as the result of the extraordinary massiveness of the bones and the heaviness of the so-called superstructures, the enormous occipital protuberance and a peculiar sagittal crest which runs along the top of the skull.

So the new skull considerably differed from the two *Pithecanthropus* skulls found earlier. But as von Koenigswald and myself were still under the spell that all human remains gathered from the Trinil formation of Java must belong to the *Pithecanthropus* type, we declared the big, massive skull to be male and the two smaller and less massive ones to be females. This was all the easier as no other upper jaw and upper teeth of *Pithecanthropus* were known. But soon I felt a little less sure of this decision when von Koenigswald informed me several months later that a new fragment of a lower jaw had been recovered from the same locality, but obviously from a larger jaw than that of 1937. Unfortunately, this new jaw is very defective, in particular in the canine and premolar regions, so that it is quite impossible to determine the real nature of this specimen as long as nothing but a cast is available. However, one thing seems to be sure. If it is an anthropoid as it appears to be, then this anthropoid is not only much shorter snouted than any known anthropoid but also has some undoubtedly human-like features. If it is a hominid, then it has some simian features not encountered so far in hominids. However this may be, Java and Dr. von Koenigswald provided us, in 1941, with an additional and still more important find which follows the same line as already indicated by the previous ones, but is so unambiguous in its morphological character that it can help us without resorting, for the moment, to the ambiguous jaw of 1939.

This new and so far latest discovery, with which we were becoming acquainted just before the occupation of Java by the Japanese cut all ways of communication, is again the fragment of a lower jaw. It is undoubtedly a human jaw, but the features which render certain this identification reveal such an early state that they stamp this jaw as the most primitive human skeleton part ever found. However, this is not the only revolutionary disclosure. Not less momentous is the fact that this jaw exceeds by far in size, especially in thickness, all that is known of any fossil or recent human jaw, including the famous Heidelberg jaw. Contrarily to the latter, the teeth of the new jaw participate in this gigantism.

Von Koenigswald, recognizing at once the human character of the fragment and, of course, also its gigantic proportions, gave the type the name *Meganthropus palaeojavanicus*. So far we have no other word from von Koenigswald, but by labelling the specimen in this way he makes known that he considers the type represented by the jaw as a giant hominid different from *Pithecanthropus*. The new find not only introduces a completely new and unexpected form into our collection of fossil hominids, it also compels us to revise our view about the uniformity of the human fossils embedded in the volcanic ashes and sands of the Trinil formation of Central Java. As a first consequence of the new knowledge we have to scrutinize again the big skull of 1939 which we ranked as a male individual among the *Pithecanthropus group*. This skull is not a true giant form when compared with the proportion of the new jaw, for the *Meganthropus* jaw is much too large and massive for it. Yet compared with the two "female" skulls found earlier, the big skull already shows a clear tendency toward gigantism and as such appears intermediate between Dubois' *Pithecanthropus erectus* and von Koenigswald's *Meganthropus palaeojavanicus*. In order to emphasize this peculiar position I have proposed to call this intermediate type *Pithecanthropus robustus*.

When we make an inventory of all the lower or upper jaws of hominids recovered from the Trinil beds, we face the singular and certainly surprising fact that all four differ in size, the smallest being the so-called *Pithecanthropus erectus* of Kedung Brubus, the largest the *Meganthropus* jaw, while the lower jaw of 1937 and the upper jaw of *Pithecanthropus robustus* fit in between the two extremes, the former again a little smaller than the latter. As these differences in size go hand in hand with differences in morphological characteristics—the larger one is in general more primitive than the succeeding smaller one—it is obvious that we have before us a group of closely related types each derivable from the other in the sequence of their size.

Before we enter into a discussion of how this fits in with the scheme of phylogenetic evolution of man and the available geological data, we must refer to another discovery Dr. von Koenigswald has made, this time not in Java but in South China. Aware of the well-known fact that the drawers of Chinese apothecaries are places where you can count on gathering rare fossil teeth and bones, he used to hunt for those curios whenever he passed through China. He was

fortunate enough to secure three strange teeth in this way, between 1934 and 1939, each time in chemist's shops in Hong Kong. The first acquired tooth, rather considerably worn but still recognizable, was a right lower molar without roots, but of gigantic proportions. In the same drawers there were, among other teeth and bones, teeth of stegodon, tapir and orang-utang, most of them without roots, but with indication that they were gnawed off. Von Koenigswald determined the big molar to be the tooth of an anthropoid and called it *Gigantopithecus blacki*. However, von Koenigswald was unable to say more about this tooth, but it was evident to him that it has no close relationship to any of the known living or fossil anthropoids. The next tooth, acquired some years later, was an upper molar also without roots but much less worn; and the latest acquired was again a third lower molar but this time a left one and only very slightly worn. The posterior root was preserved, the anterior broken or gnawed off. The degree of wear proves that the two third molars had belonged to two different individuals. Thus, *Gigantopithecus* is represented so far by two or eventually three adult individuals. But the gist of the whole story, which arouses our foremost interest, is the fact that *Gigantopithecus* is not a giant ape, as von Koenigswald assumed, but a giant man and should, therefore, be called *"Gigantanthropus."* This follows beyond any doubt from the very characteristic pattern of the occlusal surface of the teeth, which differs fundamentally in the structure of the cusps from that of any known anthropoids but agrees even in the minutest details with the hominid pattern as shown by the molars of *Pithecanthropus, Sinanthropus* and even modern man. On the other hand, the form of the teeth, especially that of the third lower molar, and the condition of its root indicate that it has preserved a very primitive character, much more primitive than the known third molars of any fossil hominid. Therefore, we have the same combination which struck us in the human fossils of Java; namely, primitiveness together with gigantic proportions. But in the case of *Gigantopithecus* the gigantism reaches a new climax. The volume of the crown of the third lower molar is about six times larger than the average crown of modern man; compared with the corresponding tooth of the gorilla, it is about twice as large.

In the case of the Javanese *Meganthropus* with a considerable part of the jaw preserved, we can risk computing the probable size of the skull and the body. If a gorilla is taken as standard size we shall not fail much in estimating that *Meganthropus* reached the size, stoutness and strength of a big male gorilla. Concerning *Gigantopithecus* we are more in the dark, because the lower and the upper molars are the only basis for calculation. Nevertheless, it seems safe to say that *Gigantopithecus* considerably exceeded *Meganthropus in size and robustness.*

The next question which arises is, of course, as to whether there is any evidence of connection between the giant hominids from Java and China, and, if so, what kind of connection exists. In spite of the deficiency of the material in both cases, and although we seemingly do not know more of the provenance of the *Gigantopithecus* teeth than the fact that they were gathered from drawers of a chemist's shop, we are surprisingly well off if we follow the traces provided by the conditions of the teeth. Teeth of stegodon, tapir and orang-utang with defective roots are common articles of commerce in South Chinese apothecaries and come from caves in the Provinces of Kwangsi, Yunnan or Szechuan, where they represent the characteristic leading fossils of the so-called "yellow deposits."[2] The same fauna is characteristic of the Trinil beds in Java, for which reason it has been called the "Sino-Malayan" fauna. *Gigantopithecus* is apparently the hominid member of this faunistic association in South China, as are *Meganthropus* and the *Pithecanthropus* group in Java. The "yellow deposits" in the South China caves belong geologically to the Lower or Middle Pleistocene. The Trinil beds in Java which yielded all the hominid material we have spoken of are also considered as Middle Pleistocene formations. But there is evidence that at least one early hominid form, the baby skull of *Modjokerto* recovered by the Geological Survey of Netherlands Indies in 1936, goes down to the Djetis bed, which belongs to the Lower Pleistocene. On the other hand, the determination of the Trinil beds as Middle Pleistocene does not exclude the possibility that some of the fossils embedded in the layers are in reality older and washed into the beds by torrents and mud streams which accompanied volcanic eruptions very frequently during this whole geological period.

As the Sino-Malayan fauna immigrated into Java from the Asiatic continent, the different hominid forms, and certainly the most primitive ones, must have taken the same way. This may have happened in the Late Pliocene or in the Lower Pleistocene, at which time south-east Asia apparently was a seat of human evolution. Therefore, neither geological nor morphological facts can be produced against the assumption that *Gigantopithecus* is an ancestral hominid

[2] Dr. C. C. Young, of the Geological Survey of China, my collaborator at the Cenozoic Research Laboratory in Peiping, who has just arrived in this country from Chungking, informs me that, according to investigations during the last few years, the caves containing the "yellow deposits" are widely distributed over the whole territory of South China south of the Yangtse River extending eastwards even to the coast, and that their fauna have the same character everywhere.

form which has been reduced in size and massiveness as it developed in the direction of modern man. *Sinanthropus pekinensis* is morphologically so close to *Pithecanthropus erectus* that he can be regarded as a parallel form of the latter. *Sinanthropus* may have taken its origin also from *Gigantopithecus,* with the only difference that in this case his transformation may have taken place on the mainland of Asia itself to the north of the original center.

All this is, of course, hypothetical and must be verified by additional and more complete material, and particularly by stratigraphic work on the sites concerned. Also the answer to another question which forces itself upon the mind has to be postponed until further evidences are at hand. Are gigantism and massiveness indispensable features of the earliest mankind and, consequently, characteristic of all human forms; or have they to be regarded as accidental, regional or individual variations as they occur in other mammalian groups? The occurrence of large fossil human skulls with very thick individual bones in early or late stages, for instance in *Homo soloensis, Homo rhodesiensis* and in the Heidelberg jaw, seem to indicate that gigantism and massiveness may have been a general or at least a wide-spread character of early mankind.[3]

ON NATURALLY OCCURRING PORPHYRINS IN THE CENTRAL NERVOUS SYSTEM[1]

By Dr. HEINRICH KLÜVER

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WE have found that the fluorescence spectrum of the white matter of the central nervous system, in numerous animals, reveals a well-defined emission band at 630–620 mμ with a maximum at about 625 mμ. When the brain and spinal cord of an adult rat are examined under the light of a mercury vapor lamp which has passed through a Corning filter No. 5874, the reddish fluorescence of the spinal cord is found to contrast strikingly with the greenish fluorescence of the cerebral and cerebellar cortex. When portions of white matter are removed from larger mammals, such as freshly killed monkeys, dogs or pigs, and examined, the 625 emission band is found to appear in the funiculi of the spinal cord, the fiber tracts of the pons and medulla oblongata, the medullary center and laminae of the cerebellum, the cerebral and cerebellar peduncles, the internal and external capsules, the corpus callosum, the fornix, the anterior commissure, the optic chiasm, the centrum semiovale and the medullary centers of the frontal, parietal, occipital and temporal lobes. The cortex and the basal ganglia, with the exception of the globus pallidus, exhibit a continuous fluorescence spectrum (about 630–430 mμ). The 625 band, although relatively weak, is found to be present in the globus pallidus, thalamus and lateral geniculate body.

Spectroscopic examination reveals the presence of the 625 band even in the white matter of a live animal. After death, the band is still present in animals killed with ether, chloroform, carbon monoxide, pentobarbital sodium, lactic acid, methylene blue, insulin, mescaline, bulbocapnine, metrazol, quinine, harmine or strychnine. Furthermore, an emission band in the red region remains present in the white matter: (1) after immersion in liquid nitrogen, (2) after boiling for 1 hour in distilled water, (3) after irradiation with 200 r or 2,000 r of x-rays and (4) after several weeks in darkness at room temperature. Exposure of the white matter to light, however, leads to a disappearance of the 625 band.

In examining the brains and spinal cords from animals of 33 different species, the 625 band has been found to be present in the white matter of all the following 25 species of mammals and birds studied: man, rhesus monkey, green monkey, cebus monkey, spider monkey, squirrel monkey, common brown bat, cat, dog, rabbit, guinea pig, rat, mouse, pig, ox, sheep, goat, hartebeest, Grant's gazelle, opossum, common rhea, duck, chicken, pigeon and great horned owl. On the other hand, we have been unable to detect the 625 band in any of the following 8 species of fully grown amphibians or reptiles: leopard frog, bull frog, iguana, gila monster, Texas collared lizard, bull snake, milk snake and indigo snake. It seems, therefore, that the fluorescence spectrum indicates the presence of a fundamental constituent of the white substance of warm-blooded animals. The position of the band and the fact that the spectrum is one of Dhéré's[2] Type I strongly suggest a porphyrin.

In an attempt to extract and identify naturally

[1] This research has been aided by a grant from the Committee for Research in Dementia Praecox founded by the Supreme Council 33°, Scottish Rite, Northern Masonic Jurisdiction, U. S. A.

[3] For details, illustrations and references the reader is referred to a paper of mine in preparation which will be published under the same title in the "Anthropological Papers of the American Museum of Natural History," Vol. 40.

[2] C. Dhéré, "La fluorescence en biochimie." Paris, 1937.

occurring porphyrins, we have chiefly used the acetic-acid-ether and the ethyl acetate-acetic acid methods.[3,4,5,6,7,8] The porphyrin which we have never failed to extract from the white matter of various mammals, including man, appears to have the characteristics of a coproporphyrin. The spectrochemical evidence has been derived from data on solubility, HCl number, and the fluorescence spectra in ether, acetic acid, 0.2, 5 and 25 per cent. HCl, concentrated H_2SO_4, pyridine, 5 per cent. $NaHCO_3$, 0.1 *N* KOH and 0.1 *N* NaOH. Measurements of the fluorescence spectra have furnished values which agree satisfactorily with those published in the literature[2,9,10] and with values found by measuring the fluorescence spectra of coproporphyrin extracted from the meconium of various animals or obtained from other sources. When the porphyrin in the 0.2 per cent. HCl fraction is driven into ether and then extracted with 20 per cent. NaOH, the porphyrin remains in the NaOH layer. There is no precipitation of insoluble sodium salts at the interface of the ether and NaOH solutions. When the porphyrin is taken into 0.2, 5 or 25 per cent. HCl and shaken with chloroform, all or almost all of the porphyrin remains in the HCl solutions. In measuring the fluorescence spectra of various porphyrins at the temperature of liquid nitrogen, we have found that the principal emission band of coproporphyrin in ether shifts about 60 Å towards shorter wave-lengths. Exactly the same shift is observed when the porphyrin in the 0.2 per cent. HCl fraction is taken into ether and studied under similar conditions. (In measuring the absorption spectra of porphyrins at liquid air temperature, Conant and Kamerling[11] have also found a shift towards shorter wave-lengths.[12]) At present we do not know whether the white matter contains coproporphyrin I or coproporphyrin III.

Extractions of the white matter also furnish varying amounts of protoporphyrin. When the original 5 per cent. HCl extract is esterified with methyl alcohol-HCl and the free porphyrins, after saponification of the ester, are studied, the spectrochemical evidence also points to the presence of coproporphyrin and protoporphyrin. No other ether-soluble porphyrins have been obtained in extracting either the white matter or the whole brain and spinal cord of normal animals.

Spectroscopic examination or extraction procedures have furnished no evidence for the occurrence of appreciable amounts of porphyrins in the pineal gland, the hypophysis, the chorioid plexuses, the cerebrospinal fluid, the aqueous and vitreous humors, and the meninges of the brain and spinal cord.

Postnatal development in mammals and birds seems to be characterized by an "ascending porphyrinization." The 625 band is not present at birth. It has been observed first in the spinal cord and, finally, in the white matter of the cerebral hemispheres. The band is definitely present in the spinal cord of rats 20 to 23 days old and in that of ducks 8 weeks old. Throughout life the band may remain more intense in the spinal cord than in the cerebrum. In numerous mammals the band appears less intense in the corpus callosum and fornix than in the centrum semiovale and less intense in the prefrontal lobes than, *e.g.*, in the occipital lobes.

The fluorescence spectra of the cranial nerves reveal marked differences. The 625 band is clearly present in the optic, trigeminal, facial and auditory nerves, but appears to be absent in the third, fourth and sixth nerves. We have not been able to detect it in the olfactory bulb. The 625 band is generally present in the olfactory tract, *e.g.*, sharp and well defined in the pig and dog, but weak or even absent in the monkey. Closer examination strongly suggests that the 625 band is always absent in the peripheral nonglial segment of the cranial nerves. Since the sensory roots contain longer glial segments than the motor roots,[13,14] the 625 band is chiefly a characteristic of sensory nerves. It is, of course, of special interest that the optic nerve contains one of the most remarkable photodynamic substances ever discovered. Although we have not ascertained the localization of the fluorescence phenomena within the white matter, the question arises whether the occurrence of porphyrin is correlated with the presence of neuroglia or, more particularly, the presence of oligodendroglia. In examining brain slices of animals with extensive cerebral lesions of long standing, the 625 band has been observed in all portions of the white substance.

[3] H. Fischer and H. Orth, "Die Chemie des Pyrrols." Vol. II, part 1. Leipzig: Akad. Verl., 1937.

[4] O. Schumm, Hdb. d. biol., *Arbeitsmethoden*, ed. by Abderhalden. Abt. IV, Teil 4, pp. 1439–1462.

[5] O. Schumm, *Arch. exp. Path. Pharmak.*, 191: 529–544, 1938.

[6] C. J. Watson, *Jour. Clin. Invest.*, 16: 383–395, 1937.

[7] K. Dobriner, *Jour. Biol. Chem.*, 120: 115–127, 1937.

[8] J. Thomas, "Contribution à l'étude des porphyrines en biologie et en pathologie." Lons-Le-Saunier, 1938.

[9] M. Borst and H. Königsdörffer, "Untersuchungen über Porphyrie." Leipzig: Hirzel, 1929.

[10] A. Stern and H. Molvig, *Zeits. physik. Chem., Abt. A*, 175: 38–62, 1935; 176: 209–225, 1936.

[11] J. B. Conant and S. E. Kamerling, *Jour. Am. Chem. Soc.*, 53: 3522–3529, 1931.

[12] The splitting up and sharpening of bands found by Conant and Kamerling also occur in the fluorescence spectra of the porphyrins. As regards the shift to the blue, it may be noted that the principal emission band shifts about 50 Å at −195° C even in the fluorescence spectrum of fox squirrel bones.

[13] H. A. Skinner, *Arch. Neurol. Psychiat.*, 25: 356–372, 1931.

[14] I. M. Tarlov, *Arch. Neurol. Psychiat.*, 37: 1338–1355, 1937.

Furthermore, a strong emission band in the red region remains present in the white matter after incubation with solutions of myelolytic substances, such as saponin or sodium taurocholate.

In view of the presence of iron-porphyrin complexes in the central nervous system it deserves emphasis that the 625 band is absent in those regions in which the absorption bands of the cytochromes are clearly present (cerebral and cerebellar cortex, caudate nucleus, putamen). The 625 band is only present in regions which have little, if any, cytochrome. Keilin[15] has expressed the view that coproporphyrin is a derivative of cytochrome. Furthermore, we have not been able to detect the 625 band in the sympathetic and spinal ganglia or in the spinal nerves.

In examining tissues and organs of various animals, we have found that in the large majority of mammals and birds the fluorescence spectrum indicates the presence of porphyrin in only one organ. This organ is the central nervous system. That the porphyrins may play a significant rôle in neurological and psychiatric disorders has been suggested by several lines of evidence.[16,17,18,19,20,21] Numerous theories have been offered to account for the fact that acute porphyria produces such a wide variety of nervous and mental symptoms. In relating our results to facts and considerations reported in the literature, we are led to the hypothesis that certain neurological and psychiatric disorders are associated with a "cerebral porphyria" or a disturbance of the metabolism of certain pyrrol compounds.[22] Investigations are in progress to determine the distribution, amounts and kinds of porphyrins occurring in the brains and spinal cords of patients with various neurological and psychiatric disorders, ranging from demyelinizing diseases to the major psychoses.

OBITUARY

THOMAS SCOTT FISKE

THOMAS SCOTT FISKE was born in New York City on May 12, 1865. He was the son of Thomas Scott Fiske, a business man of New York, and Clara Pittman. He studied at the Old Trinity Church School in New York City, and at the Pingry School in Elizabeth, N. J. He entered Columbia College in 1881, obtaining the A.B. degree in 1885, and continued graduate work in the university, earning the A.M. in 1886 and the Ph.D. in 1888.

His principal teacher at Columbia College was Professor Van Amringe, and Fiske was his assistant for several years. Van Amringe advised him to continue the study of higher mathematics at the University of Cambridge, England. This wise advice had a great influence on Fiske's intellectual career. (It will be recalled that most mathematicians of his period studied in Germany.)

Fiske was fortunate in arriving in Cambridge with letters of introduction from one of the Columbia trustees, George L. Rives, who had himself studied in Cambridge many years before, had in fact been one of the wranglers at the mathematical tripos in 1872, and had been offered a fellowship at Trinity, a very high honor. These letters were addressed to the well-known mathematicians, Cayley, Glaisher, Frost, Forsyth and George Darwin. So young Fiske was welcomed as a guest and attended lectures by most of these men. He also did private reading with Dr. H. W. Richmond.

Fiske himself stated that the teacher of greatest influence was Dr. Glaisher, who made him an intimate friend and traveled with him to London to meetings of the London Mathematical Society. To quote Fiske's own words: "On my return to New York I was filled with the thought that there should be a stronger feeling of comradeship among those interested in mathematics and I proposed to my classmates and friendly rivals, Jacoby and Stabler, that we should try to organize a local mathematical society."

These three young men, all born in the year 1865, sent out an invitation to local mathematicians, and on November 24, 1888, the first meeting was held in Columbia College, attended also by Van Amringe, Rees and Maclay. Thus began formally the New York Mathematical Society, with Van Amringe as president and Fiske as secretary. The society grew very rapidly, new members coming from Harvard, Yale, Princeton and Johns Hopkins. Six years later the membership was really national and the name of the organization was therefore formally changed to the American Mathematical Society. It is now the largest and most influential mathematical society in the world, having a membership of about three thousand. Fiske was the first secretary and the seventh president. He played the leading role in founding the two leading scientific journals, *The Bulletin* (1891) and *The Trans-*

[15] D. Keilin, *Proc. Roy. Soc. London (B)*, 98: 312–339, 1925.

[16] J. Waldenström, *Acta med. scand.*, suppl. 82: 1–254, 1937.

[17] J. Waldenström, *Acta psychiat. neurol.*, 14: 375–379, 1939.

[18] H. Günther, *Ergebn. allg. Path. path. Anat.*, 20, part 1: 608–764, 1922.

[19] A. Vanotti, *Ergebn. inn. Med. Kinderhk.*, 49: 337–377, 1935.

[20] P. Eichler, *Zeits. ges. Neurol. Psychiat.*, 141: 363–379, 1932.

[21] C. Carrié, "Die Porphyrine." Leipzig: Thieme, 1936.

[22] H. Klüver, *Jour. Psychol.*, 17: 209–227, 1944.

actions (1900), and served on the board of editors in each case.

On the fiftieth anniversary of the society in 1938, Fiske received all honors as founder of the society. His portrait was painted for the occasion and now hangs in the rooms of the society in the Low Library of Columbia University. A full history of the first fifty years of the society, including a most complete account of Fiske's life and services, was written by Professor Archibald, of Brown University.[1]

Fiske was rapidly promoted in the department of mathematics at Columbia, becoming full professor in 1897 and the executive officer in 1915. He was an enthusiastic lecturer, equally interested in undergraduate and graduate work, inspiring many students. His main courses were in the theory of functions and differential equations. He published several technical papers in his early years, and a valuable monograph on functions of a complex variable, but his chief literary work was in the role of editor.

Fiske's name will always be connected with the American Mathematical Society, and also with another important organization, the College Entrance Examination Board. This was started in 1900 and the first secretary was Professor Nicholas Murray Butler. When Dr. Butler resigned as secretary, just before becoming president of Columbia, he asked Professor Fiske to take over the work, and to regard this service as a real portion of his duties as a professor, promoting the course of general education. Fiske was secretary from 1901 to 1936. Under his wise guidance the board grew from a small organization, examining 1,000 candidates for admission to twenty colleges, to 23,000 candidates to two hundred colleges.

When Fiske retired from Columbia and from the College Board in 1936, he settled in Poughkeepsie with his daughter, living the life of a country gentleman and keeping up many scholarly interests, until his death on January 10, 1944.

EDWARD KASNER
COLUMBIA UNIVERSITY

DEATHS AND MEMORIALS

DR. NORTON ADAMS KENT, who founded the department of physics at Boston University and was professor of physics there until his retirement in 1942, died on June 5 at the age of seventy years.

DR. FREDERICK G. REYNOLDS, since 1891 until his retirement with the title emeritus in 1943 professor of mathematics and head of the department of the College of the City of New York, died on June 9 at the age of seventy-two years.

FREDERIC H. FAY, senior member of Fay, Spofford and Thorndike, engineers, Boston, a member of the Boston Planning Board for twenty years, died on June 5 at the age of seventy-one years.

DR. AMOS ARTHUR HELLER, botanist of Chico, Calif., died at Vacaville, Calif., on May 18. He had at various times been connected with the University of Minnesota, the U. S. Department of Agriculture, the New York Botanical Garden and the University of Nevada.

THE *Journal* of the American Medical Association reports that a portrait of the late Dr. Howard Taylor Ricketts, who died of typhus in Mexico City on May 3, 1910, was unveiled on June 11 in the Archibald Church Library of the Northwestern University Medical School. The portrait is the gift of Mrs. Howard T. Ricketts and was presented by Dr. Henry T. Ricketts, son of Dr. Ricketts. It was unveiled by Robert Howard Palmer and Howard James Ricketts. Dr. Ludvig Hektoen, after an introduction by Dr. Irving S. Cutter, dean emeritus of Northwestern University Medical School, delivered the principal address. The portrait will hang permanently in the Archibald Church Library. A special exhibit of memorabilia depicting the work of Dr. Ricketts, who contracted typhus while carrying on research on the disease, will be on display.

SCIENTIFIC EVENTS

THE HAWAIIAN ACADEMY OF SCIENCE

THE Hawaiian Academy of Science held its eighteenth annual meeting on the evenings of April 27, 28 and 29 at the University of Hawaii, Honolulu. Scientific papers were presented on the first two evenings, and on Saturday the annual dinner and business meeting were followed by the address of the retiring president, Professor Carey D. Miller, who spoke on "Some Aspects of Growth and Food Needs."

For two years, owing to blackout restrictions and attendant travel difficulties, no evening meetings were held and meetings this year marked the return to the usual pre-war program. The average attendance has been about ninety. Thirty nominees were elected to membership. Officers elected for the coming year were: J. L. Collins, *President;* Peter H. Buck, *Vice-president;* Chester K. Wentworth, *Secretary-Treasurer;* T. A. Jaggar, Jr., and Colin G. Lennox, *Councilors* for one and two years, respectively; and Carey D. Miller, *Councilor, ex officio.*

The Hawaiian Academy of Science was founded in

[1] American Mathematical Society Semicentennial Publications, Vol. 1, 1938. I have borrowed most of my facts from this volume.

1925 and has a membership of about two hundred and seventy. An unusually wide range of interests is represented by the membership, both in special subjects in natural and social subjects and in the institutions by which they are employed, including the university and other educational institutions, the Bishop Museum, private and government experiment stations, various government agencies dealing with water supply, plant and insect control, public health and the like, as well as local clinics and hospitals and the military services. Contrasted climatic problems, geographic insularity and diversified racial and cultural patterns and trends in Hawaii have combined with a vigorous financial-industrial status to produce a varied and healthy development of scientific activity which on a per capita basis is probably matched in very few areas in the world.

The following papers were presented at the scientific sessions: "Summary of a Chemical and Physiological Study of the Toxic Principle in *Leucaena glauca* (Koa Haole)," by Ruth Yoshida (presented by J. H. Beaumont); "Certain Biological Aspects of Mosquito Control in Hawaii," by David D. Bonnet; "Fishery Research in Hawaii," by Christopher J. Hamre; "Exchangeable Potassium in Some Oahu Soil Profiles," by A. S. Ayers and C. K. Fujimoto; "Flow of Liquids through Narrow Cracks," by Chester K. Wentworth; "Active Volcanoes in the War Zones," by T. A. Jaggar with the assistance of Gunnar Fagerlund.

CHESTER K. WENTWORTH,
Secretary

THE SCHOOL OF PUBLIC HEALTH OF THE UNIVERSITY OF CALIFORNIA

THE first School of Public Health west of the Mississippi has been established at the University of California. The school was set up by the Board of Regents after the State Assembly passed a bill appropriating funds. Dr. Walter H. Brown, chairman of the department of hygiene, has been appointed acting dean.

There has long been need for a training center in the western part of the continent to train public-health personnel for service not only in the western United States, but for service in the entire Pacific Basin and Latin America. It is expected that the new school will operate as such a training center.

The providing of courses and curricula on both undergraduate and graduate levels is contemplated, and plans will be developed for the graduate training of health officers, epidemiologists, public health engineers, industrial hygienists and other specialists.

Planned as a university-wide undertaking, using the resources of all campuses, the school is being organized as a cooperative enterprise, involving the participation of several other schools and departments within the university, including those in the fields of medicine, medical research, education, nursing, home economics and sanitary engineering. The department of hygiene will be renamed the department of public health and will function as part of the School of Public Health.

Among the first service activities of the school were two special training courses for sanitarians, one being given at Berkeley during the spring semester and one at Los Angeles during the summer term. These courses were requested by the State Department of Public Health to help to meet increasing demands on public health workers in coping with emergency conditions in the western states. They are open to public-health personnel selected by Boards of Health in California and adjacent states. The courses consist of eight weeks' academic instruction and four weeks' field work.

At the request of the Coordinator of Inter-American Affairs through the Division of Health and Sanitation fifteen Latin American students are being trained specifically for health education activities in their respective countries. Their program consists of two sixteen-week terms and will cover problems of nutrition and personal hygiene, communicable diseases, environmental sanitation, general education and sociology, public health administration and health education.

In addition to the faculty of the School of Public Health the teaching staff for the Latin American program will include Dr. Clair E. Turner, head public health education officer, Division of Health and Sanitation, Office of Coordinator of Inter-American Affairs; members of the School of Education and the departments of home economics and social welfare at Berkeley; the Medical School at San Francisco; and representatives of the U. S. Public Health Service, the Children's Bureau of the Department of Labor and the State Department of Public Health.

At the conclusion of the two academic terms at Berkeley, the Latin American students will spend a period in field practice as a final preparation for their duties upon returning to their home countries.

THE GUTHRIE LECTURE

DR. JOEL H. HILDEBRAND, professor of physical chemistry at the University of California, who has been in London during the past year as a scientific liaison officer for the Office of Scientific Research and Development attached to the American Embassy, is now in the United States on a brief furlough. Dr. Hildebrand delivered the Guthrie Lecture at the Royal Institution, London, on April 26. It was repeated at the Clarendon Laboratory of the University of Oxford on April 29. The subject of the lecture was "The

Liquid State." Dr. Hildebrand expects to return to London at an early date.

The introduction to the lecture was made by Professor E. N. da Costa Andrade, Quain professor of physics at the University of London, adviser to the director of scientific research of the British Ministry of Supply, who spoke as follows:

We are met to-day for our chief annual function, the Guthrie Lecture. For the benefit of our guests and new fellows, I may explain that it was founded in 1914 to perpetuate the memory of our founder, Professor Guthrie, who himself became our president in 1884, ten years after the foundation of the society. We have to deplore the death, since our last lecture, of Mrs. Guthrie, who always attended, but we are pleased to be able to welcome members of the Guthrie family, as usual.

This lecture has been given in the past by many distinguished men. Among our own countrymen I may recall the names of Sir J. J. Thomson, Lord Rutherford, Sir C. V. Boys, Lord Cherwell, Professor A. V. Hill, Sir Edward Appleton; among Frenchmen, Langevin, Guillaume and Fabry; among Germans, Wien and Planck; among Scandinavians, Bohr and Siegbahn. The very first Guthrie Lecture was given by an American, Professor R. W. Wood, and on three other occasions we have been addressed by Americans—Albert A. Michelson, P. W. Bridgman and A. H. Compton, a distinguished company indeed. This year we have the great pleasure of adding another American name to the list, that of Professor J. H. Hildebrand. Bridgman and Compton were from Harvard, near the extreme east of the States; Wood was from Baltimore, not so far distant; Michelson from Chicago on the Great Lakes. This year we travel to the West Coast, to Golden California, and borrow one of her choicest spirits.

And here I may say that we have been brought up to believe that everything in California is very large. As the poet says:

> And the cattle on the hills of California
> And the very swine in the holes,
> Have ears of silk and velvet,
> And tusks like long white poles,

and that perhaps at first we were a little bit disappointed that Hildebrand was not bigger, but we soon got to know that his heart was built on a Californian scale.

It is not often that our council has had so easy a task in choosing the Guthrie lecturer as they had this year. It is seldom that in any of the affairs of life the heart and the head can agree completely, and still more seldom that they can then make common cause with international politics. This year, however, the promptings of friendship, the pleadings of reason and the pressure of political feeling all urged us to choose Dr. Hildebrand. I have put friendship first, because many of those present —and by many I mean all those who know him personally—feel for him something more than mere regard. His unaffected good will, his geniality, his modesty and his good fellowship have endeared him to his English colleagues. But even if he had been less cordially liked we should probably have asked him to deliver this lecture because of his eminence as a physical chemist and, in particular, because of the interest of his subject and of its novelty to most of us. And even if he had been only tolerably liked and moderately distinguished, even if his appeal to our hearts and our heads had been less strong, we should still have liked to have him here to-day as a gesture of affection to our American colleagues with whom we work in such amity in the fields of science. As it is, everything conspired to commend Dr. Hildebrand to us and it was with the greatest pleasure that we received his favorable answer to our invitation.

To-day is something of an American occasion. I have already referred to our former Guthrie lecturers from the United States. By courtesy of the managers we are able to assemble in the lecture theater of the Royal Institution. The institution was founded in 1799 by the celebrated Benjamin Thompson, Count Rumford, who was an American by birth and upbringing and who spent much time in this very theater. I am glad to say that among the small number of honorary members of the institution are a good proportion of Americans, including Professor G. N. Lewis, of the University of California.

Here Professor Andrade read a letter from Ambassador Winant regretting his inability to attend.

And now, in the name of the council of the Physical Society, I invite you, Dr. Hildebrand, to deliver the twenty-eighth Guthrie Lecture and I assure you that you have before you an audience of friends.

At the close of the lecture a vote of thanks was moved with appropriate remarks by Professor Oliver Rankin, formerly president of the Physical Society, and seconded in like manner by Sir Henry Dale, president of the Royal Society. At Oxford the same ceremony occurred, with the vote of thanks moved by Lord Cherwell and seconded by Professor N. V. Sidgwick.

HONORS IN THE SCIENCES AWARDED BY COLUMBIA UNIVERSITY

AT the one hundred and ninetieth commencement of Columbia University the doctorate of science was conferred on Dr. Lyman James Briggs and Te-Pang Hou. The citations were as follows:

LYMAN JAMES BRIGGS: Physicist; native of Michigan who quickly turned to scientific work of high importance and passed from one post of honor and confidence to another; becoming in 1933 director of the Bureau of Standards; closely associated with a score of important scientific organizations and undertakings; always a stimulating leader in thought and research.

TE-PANG HOU: Chemist and engineer; born in China and trained first in his homeland and afterwards in the United States; returning to China for pioneer service in establishing for the first time on the continent of Asia a modern chemical industrial plant of imposing productive capacity, thus enabling the West to repay in part a debt centuries old to the Chinese nation.

University medals were awarded to:

CHESTER ALAN FULTON: E.M., 1906; president of the

American Institute of Mining and Metallurgical Engineers; most effective administrator and research worker in his chosen field.

JAMES TAYLOR KEMP: B.S., 1912; Met.E., 1916; metallurgist of distinction; now in England as a member of the Mission for Economic Affairs.

SCIENTIFIC NOTES AND NEWS

THE University of Florida at its commencement on May 29 conferred the degree of doctor of science on Dr. Thomas Barbour, director of the Museum of Comparative Zoology of Harvard University.

THE University of Akron, Ohio, conferred on June 4 the honorary degree of doctor of science on Bradley Dewey, director of the Office of the Rubber Division of the War Production Board. Mr. Dewey was the guest speaker, his topic being "Synthetic Rubber and the University of Akron—Now and in the Future."

THE honorary degree of doctor of science was conferred at the commencement of the University of Maine on Dr. William H. Martin, dean of the College of Agriculture and director of the Agricultural Experiment Station of Rutgers University, in recognition of "splendid achievements in the fields of education and science."

AT the one hundred and twelfth commencement of New York University the doctorate of science was conferred on Dr. Otto Loewi, research professor of pharmacology at the university.

THE Trudeau Medal for meritorious achievement in the prevention and treatment of tuberculosis of the National Tuberculosis Association was awarded on May 10 at a meeting in Chicago to Dr. James Alexander Miller, professor of clinical medicine at the College of Physicians and Surgeons of Columbia University and director of the Tuberculosis Clinic of Bellevue Hospital.

THE Royal Society of Canada, at its meeting in Montreal on May 29, awarded the Henry Marshall Tory Medal to Frank Allen, professor of physics at the University of Manitoba, "in recognition of his researches in the senses of vision, hearing, touch and taste." Dr. Allen, who founded the department of physics in 1904, was professor of physics and head of the department. He will retire on August 31. He has been appointed professor emeritus effective on September 1.

DR. HOWARD MUMFORD JONES, dean of the Graduate School of Arts and Sciences of Harvard University, has been elected president of the American Academy of Arts and Sciences, Boston.

AT the anniversary meeting of the Royal Institution, London, Lord Eustace Percy was elected president and Major Charles E. S. Phillips was elected secretary.

PROFESSOR GRACE MACLEOD, professor of nutrition at Teachers College, Columbia University, chairman of the Nutrition Committee of Greater New York, is retiring with the title emeritus after teaching at the college for twenty-five years. Students of the class in nutrition for 1944 are starting a Grace MacLeod Loan Fund for graduate students in nutrition at the college.

PROFESSOR MARSHALL KAY, in charge of instruction and research in stratigraphy in the department of geology of Columbia University, has been promoted from an associate to a full professorship.

DR. MORRIS STEGGERDA, who has been connected for the past fifteen years with the department of genetics of the Carnegie Institution at Cold Spring Harbor, has been appointed professor of anthropology at the Kennedy School of Missions, a division of The Hartford Seminary Foundation.

DR. LESLIE W. FOKER, director of the Minnesota Division of Industrial Health, is chairman of a new industrial nutrition committee, established in cooperation with the Nutrition in Industry Service of the U. S. Food Distribution Administration.

DEAN WILLIAM I. MYERS, of the New York State College of Agriculture; Dr. L. A. Maynard, director of the School of Nutrition at Cornell University, and C. Chester Dumond, New York State Commissioner of Agriculture, have been appointed members of a New York State Postwar Planning Committee to avoid chaotic food conditions after the war.

DR. ERNEST J. JAQUA, Eugene, Ore., formerly president of Scripps College, Claremont, Calif., has been appointed educational director of the Baruch Committee on Physical Medicine. Members of the scientific advisory committee are Dr. Frank H. Krusen, Rochester, Minn., *Chairman;* Dr. Jaqua, *Secretary;* Dr. John Stanley Coulter, Chicago; Dr. John Farquhar Fulton, New Haven, Conn.; Dr. Charles Gordon Heyd, New York; Dr. Andrew C. Ivy, Chicago; Dr. Chauncey D. Leake, Galveston, Texas; Dr. Frank R. Ober, Boston; Dr. Winfred Overholser, Washington, D. C.; Dr. Francis O. Schmitt, Cambridge, Mass., and Dr. Ray Lyman Wilbur, Stanford University, Calif., member *ex officio.*

THE Worcester Foundation for Experimental Biology announces the appointment of three new research members: Dr. Erwin Haas, of the University of Chicago; Dr. Robert P. Jacobsen, of the U. S. Public Health Service, and Dr. Oscar M. Hechter, of the

University of Southern California. Dr. Haas's work is primarily in the field of respiratory enzymes. Dr. Jacobsen is a steroid chemist, and Dr. Hechter's contributions have been primarily in endocrinology.

DR. JOHN HARLAND PAUL, in charge of malaria control in Haiti, has been appointed director of the Bureau of Malaria Control of the Florida State Board of Health.

DR. LAWRENCE W. BASS, director of the New England Industrial Research Foundation, Boston, previously assistant director of Mellon Institute, has been appointed associate director of chemical research for the Air Reduction Company, Inc., and the United States Industrial Chemicals, Inc.

DR. JACOB SACKS, formerly assistant professor of pharmacology of the Medical School of the University of Michigan, has joined the staff of Endo Products, Inc., as director of the pharmacological laboratory.

DR. RAMON F. HANZAL, assistant professor of pathological chemistry at the School of Medicine of Western Reserve University, has become a biochemist with the Killian Research Laboratories in New York City.

DR. LAWRENCE C. CURTIS, geneticist at the Connecticut Agricultural Experiment Station, who has been a member of the staff for fourteen years, has been granted a year's leave of absence to serve as a member of a food mission to North Africa with the Division of Relief and Rehabilitation of the Foreign Economic Administration. The mission will study the production of food crops in North Africa and the distribution of these crops to the Allies and to liberated countries.

DR. PAUL O. MCGREW, of the division of geology of the Chicago Natural History Museum, left for Mexico on June 8 to make a study of the volcano El Parícutin, which on February 20, 1943, erupted suddenly. Since that time it has grown into a volcanic cone rising 1,200 feet above the ground surface, giving out volcanic bombs, cinders and ash and clouds of gases.

DR. HARLOW SHAPLEY, director of the Harvard College Observatory and national president of the Society of the Sigma Xi, gave the address at the spring initiation meeting of the Smith Chapter on April 11. The title of the lecture was "Reaching for the Stars."

DR. C. E. KENNETH MEES, director and vice-president of the Eastman Kodak Company, will be the speaker at the dinner on June 23 of the Rochester meeting of the American Physical Society and the American Association of Physics Teachers. The address will be entitled "The New World and the Scientist."

THE inaugural meeting of the new Division of High-Polymer Physics of the American Physical Society will be held on June 23 and 24 at the University of Rochester. A program of approximately twenty selected papers on the elasticity, viscosity and other physical properties of high-polymeric materials, as well as on the application of physical methods to manufacturing processes, has been arranged. Recognizing the expansion in the applications of physics and physical techniques arising from the recent rapid development of the field of high-polymeric materials, the council of the society last November authorized the establishment of the division. Its object is the advancement and diffusion of the knowledge of the physics of high-polymeric materials. The interests of the division will be sufficiently broad to appeal to physicists in academic, industrial and governmental laboratories. The inaugural program at Rochester is being sponsored by members of an organizing committee of which Dr. W. J. Lyons, Southern Regional Research Laboratory, 2100 Robert E. Lee Boulevard, New Orleans 19, Louisiana, is serving as secretary.

THE fifty-seventh regular meeting of the Iowa Academy of Science was held in Cedar Rapids on April 15. The attendance was about two hundred, and papers were read before the sections of botany, chemistry, geology, mathematics, physics, psychology, science teaching and zoology. Dr. E. R. Smith, of the Iowa State College, delivered the presidential address; Dr. J. N. Martin and Dr. C. W. Lantz presented papers of general interest; Dr. L. R. Laudon, of the department of geology of the University of Kansas, gave an illustrated address entitled "Oil from the Arctic." Sixty-eight papers were presented at meetings of the sections. Officers of the academy elected for 1944–45 are: *President,* Ben H. Peterson, Coe College; *Vice-president,* Joseph C. Gilman, the Iowa State College; *Secretary-Treasurer,* Cornelius Gouwens, the Iowa State College.

THE first annual meeting of the Potomac Division of the American Phytopathological Society at the station of the Bureau of Plant Industry at Beltsville, Md., was a war conference to facilitate an exchange of ideas among the plant pathologists of Maryland, Delaware and the U. S. Department of Agriculture. The attendance was approximately one hundred. Nineteen papers representing results of original research were presented. In addition to the research papers, quarantine protection problems and war-time work in plant pathology were discussed. Officers for the Potomac Division for 1945 are: *President,* H. B. Humphries; *Vice-president,* W. J. Zaumeier; *Secretary-Treasurer,* T. F. Manns, and *Representative on Council,* H. P. Barss.

THE semi-annual meeting of the American Society

of Mechanical Engineers will be held at Pittsburgh from June 19 to 22. In addition to a full program of technical papers, there will be a panel discussion on developments in industrial furnaces; a symposium on instrument controls action and one on controlled atmospheres in metals engineering. Igor I. Sikorsky will be the speaker at the dinner of the society on the evening of Wednesday, June 21.

THE Washington Branch of the American Association of Scientific Workers has arranged a symposium for Friday evening, June 16, at 8 o'clock, in the Auditorium Archives Building on "The Utilization of Scientific Personnel in Wartime" under the chairmanship of R. H. Montgomery, economic adviser to the executive director of the Foreign Economic Administration. The speakers are Dr. Vannevar Bush, director of the Office of Scientific Research and Development, and Colonel John N. Andrews, office of the director of the Selective Service System.

THE Fifth Conference on Science, Philosophy and Religion will meet at the Men's Faculty Club of Columbia University over the week-end of September 7. In accordance with the practice adopted last year, attendance will be limited to members and participants in the program. There will be no public meetings.

AT the ninety-seventh annual general meeting in London of the British Palaeontographical Society, a committee was appointed to consider plans for the commemoration in 1947 of the centenary of the society.

THE John and Mary R. Markle Foundation has authorized a grant-in-aid of $5,400 annually, for a two-year period, in support of research on experimental renal hypertension at the University of Illinois College of Medicine, Chicago. The work, which was initiated in 1942, under a two-year grant of $7,000 from the foundation, is being conducted under the direction of Dr. George E. Wakerlin, professor of physiology and head of the department.

THE Sugar Research Foundation has made grants amounting in all to $104,000 for research on sugar to the following recipients: Dr. Ancel B. Keys, professor of physiology at the University of Minnesota; Dr. Julian A. Boyd, associate professor of pediatrics at the Iowa State University; Dr. Frederick J. Stare and Dr. A. Leroy Johnson, both of the School of Medicine and Public Health of Harvard University; Dr. Melville L. Wolfrom, professor of chemistry at the Ohio State University, and Dr. Carl Neuberg, professor of chemistry at the Washington Square College of New York University.

THE University of Arizona is acquiring the private herbarium of Dr. Forrest Shreve, of the Carnegie Institution of Washington. The collection contains 30,000 specimens and is recognized as an excellent representation of the Mexican flora. About half the specimens are from Mexico, mainly from the northern half of that country. The other half of the collection is chiefly from the southwestern states with about 1,500 sheets from Maryland, Georgia and Alabama, and an undetermined number from Jamaica. The Mexican plants include a considerable number of old collections made by Pringle, Palmer, Marcus Jones and Purpus. The more recent material includes sets of nearly all the important collections that have been made in Mexico since 1930. Included among the specimens are nine types, about 200 topotypes and about 300 isotypes.

CHANGES in the undergraduate curriculum of the Massachusetts Institute of Technology to meet the special requirements of education in science, engineering and architecture after the war have been approved by the faculty. The plan is the result of months of study by a faculty committee appointed to consider simplification of courses. Members of the committee were Professor Earl B. Millard, *Chairman;* Professor Leicester F. Hamilton, Registrar Joseph C. MacKinnon, Professor George W. Swett, Professor Arthur L. Townsend, Professor Carlton E. Tucker and Professor Bertram E. Warren. The most important feature of the revision is a coordinated four-year program in the humanities and social sciences which emphasizes the long-established educational philosophy of instruction of the institute in the ethical and social implications of science and technology.

DISCUSSION

A NOTE ON EQUATIONS OF GROWTH[1]

IT is an altogether too well-known fact that the growth of diverse cellular populations can not be described by a single growth equation, merely by changing the numerical values in the "constants" so as to fit each case. Much less realized is the equally evident fact that a single differential equation with

[1] In accordance with Art. 113(2) U. S. Navy Regulations, the opinions or assertions contained herein are the private ones of the writer, and are not to be construed as official or reflecting the views of the Navy Department or Naval Service at large.

fixed constants is generally unable to describe even the entire lifetime of one cell community. The first of these serious difficulties suggests that an equation may be too committing and limited and is thus unable to grasp the "common denominator" of all growth. A promising solution to this problem is to fix attention on the form of the differential or integro-differential equation. This point of view has been argued elsewhere.[2] The function most commonly used, and for which there is considerable theoretical justification, is the polynomial in N,

$$\frac{dN}{dt} = h_1 N^{\gamma_1} + h_2 N^{\gamma_2} + \ldots\ldots\ldots + h_m N^{\gamma_m} \qquad (1)$$

where N is the cell number (or some parameter linearly proportional to it), and the h_j are aptly[3] called the vital coefficients. In recognition of the first-mentioned difficulty of the growth problem, it is to be understood that only some of the terms in (1) will appear, depending on what sort of growth is being analyzed. The second difficulty—with which this paper is concerned—leads to the further admission that the h_j are in some way dependent on time. This situation has been clearly realized by Kostitzin (*ibid.*), who has suggested an analytic treatment based on dividing up the life span of the colony into physiological phases. He then writes for each phase one equation with constant vital coefficients. The values of these constants, however, change discontinuously from phase to phase, while the final value of N in one phase becomes the initial value of N in the next. While in a qualitative sense the notion or discrete physiological phases is useful, it is obvious that a full treatment of the problem must be based on analyzing continuous changes. This involves giving rational interpretations to the vital coefficients, and therefore explicitly predicting how they shall vary in time. An attempt of this sort has been made elsewhere.[4] In certain cases the resulting differential equation is directly integrable. Such a procedure is what might be called the direct solution of the growth problem.

Usually, however, it is impossible to solve the differential equation by any practical method, and one must wait upon the evolution of other procedures. In the meantime the following simple analysis can be of considerable value.

Let us suppose that on the basis of a knowledge of the physical situation one writes the differential equation of the system as,

$$\frac{dN}{dt} = \sum_{j=o}^{j=m} h_j N^{\gamma_j} \qquad (2)$$

[2] M. F. Morales and N. W. Shock, *Bull. Math. Biophys.*, 4: 63, 1942.

[3] V. A. Kostitzin, "Mathematical Biology," George S. Harrap, London, 1939.

[4] M. F. Morales and F. L. Kreutzer, submitted.

Defining two differential operators, H:

$$H^0 \equiv 1$$

$$H^1 \equiv \frac{1}{\frac{dN}{dt}} \frac{d}{dt}$$

We may generate from (2) the set of equations by successive application of the H:

$$H^i\left(\frac{dN}{dt}\right) = \sum_{j=o}^{j=m} h_j \left[\frac{\gamma_j!\, N^{\gamma_j - 1}}{(\gamma_j - i)!}\right], \quad i = 0, 1, 2 \ldots\ldots \qquad (3)$$

So far as the h_j are concerned (3) is a linear set. Letting i run to the value m, it is evident that the values of all the h_j *at the point* (N, t) can be determined by usual methods as,

$$h_j = \frac{\begin{vmatrix} p_{oo} & p_{o1} & \ldots\ldots & p_{jo-1} H^0 \frac{dN}{dt} & \ldots\ldots & p_{on} \\ \ldots\ldots & & & & & \\ p_{io} & p_{i1} & \ldots\ldots & p_{ij-1} H^i \frac{dN}{dt} & \ldots\ldots & p_{in} \\ \ldots\ldots & & & & & \\ p_{mo} & p_{m1} & \ldots\ldots & p_{mj-1} H^m \frac{dN}{dt} & \ldots\ldots & p_{mm} \end{vmatrix}}{|p_{ij}|}$$

where $p_{ij} = \dfrac{\gamma_j!\, N^{\gamma_j - 1}}{(j-i)!}$ or 0 according as $j \geqq i$ or $j < i$,

provided that N and all the $H^i\left(\dfrac{dN}{dt}\right)$ be known. This is by no means a hopeless task. The experimental curve of the growth gives N. Well-known graphical methods give $\dfrac{dN}{dt}$ and by the indicated combinations of these it is possible to obtain all the products of the operator H. These operations are then performed for as many points as are consistent with accuracy and convenience.

The result is that by straightforward and simple methods it is possible to follow the time changes in the vital coefficients, and therefore to support or disprove the theoretical interpretation that has been assigned to them. This in turn substantiates or vitiates the differential form (1) attempted.

MANUEL F. MORALES, *Ensign, U.S.N.R.*

TRANSLITERATION OF RUSSIAN NAMES AND WORDS

IN the course of the past months a number of notes appeared in SCIENCE in relation to transliteration of Russian names and words into English. The latest of these is that by C. S. Hoare (April 21 issue of SCIENCE).

I wish to point out that one factor appears to escape the discussion in most cases. It is simply this: Is the transliteration to be used for filing purposes and be independent of the language of the user, or is it to be a guide for writing the proper sound of the

Russian words in the language of the user and thus make him able to pronounce the words reasonably accurately?

If the former is the case, then, of the number of systems which have been presented, there does not seem to be a single one which is adopted universally, which is unfortunate.

If the latter, however, is the case, then surely no point is gained in using Chech alphabet to signify Russian words to an English-speaking person. The latter would have to learn Chech to learn Russian. Surely, the direct process is simpler and more direct. I wish to point out that for the purposes of both reasonably correct pronunciation and ready filing, the system used by the *Chemical Abstracts* (readily obtainable by writing to the editor) is by far the simplest and reduces Russian to English letters and not to some third intermediate or synthetic language.

G. M. KOSOLAPOFF

DAYTON, OHIO

EDITORIAL CHANGES OF SCIENTIFIC PAPERS

THE discussions on editorial changes of scientific papers which have appeared in SCIENCE[1] have been very valuable—not alone because they have discussed equine serum and horse serum but because they have brought out several worthwhile points of view. May I add to the discussion for what it may be worth, and may I by way of introduction suggest that the *Proceedings* of the American Society for Horticultural Science, to which I am referring and in which I have a hand, is not being held up as an example of superior editing. It has, however, over a period of years developed an editorial policy which leaves to the author the final decision in controversial matters. And this has come about in part through a number of sad experiences.

First, about twenty-five years ago a manuscript was submitted by a young scientist, which was rejected by our editorial committee and later published in an experiment station bulletin. The bulletin has become a classic in the literature of plant science. Second, about ten years ago, a paper by a recognized authority in genetics was submitted anonymously to another recognized authority in genetics for review. The reviewer termed the paper inconsequential and branded the author as knowing little about the field of genetics. The author in turn replied that the reviewer did not understand the paper and evidently was not a geneticist. Experiences such as these leave an editor shuddering and horrified. Needless to say, they affect one's viewpoint.

And so, the editorial policy of the American Society for Horticultural Science has been to throw the responsibility back upon the author. We say to the reviewer, "Final approval or rejection of suggestions lies with the author. . . . Suggestions are to be considered from the standpoint of being helpful to the author in presenting the data." We say to the author, "You are at liberty to accept or reject the criticisms." Obviously, editorial supervision is exercised over elementary spelling and grammar, but these are hardly matters of controversy. And, where an author prefers, "scion" becomes "cion," "clone" becomes "clon" and "sweetpotato" becomes two words. By common standards this is, of course, poor editing.

But we do try to have the material understandable, and we try to help the author to this end. We lean, though we do not encourage it, towards the side of letting a man "make a fool of himself in his own way." And sometimes he proves to be not so much of a fool as was at first suspected.

In short, our policy is focused around an attempt to be helpful; we try to humanize the relation between editor and author; we suggest changes and leave to the author the final judgment and control of the situation. The result is a very gratifying response, close understanding and excellent working relations.

To be sure, the topic of editorial supervision and control is not quite so simple as this point of view might seem to imply. There are such matters to consider as cost of printing, space on library shelves, cluttering of the literature, nature of the publication medium, nature of the material to be published, audience to be served, helpfulness to the reader and even protection of the author from himself. They carry different weights in different situations.

Stuart P. Sherman once said to his class in English at the University of Illinois, following an address by Sergeant Alvin C. York, in which there was some criticism of the grammatical expressions used by Sergeant York in addressing the German machine gunners, "They understood him, didn't they?" The point is that part of the effectiveness of Sergeant York's reply was in the way he said it—it was distinctly his way, and as such it may have carried far clearer meaning than had it been altered by an editorial committee to suit some arbitrary standards. At least, "he got results."

H. B. TUKEY,
Secretary, American Society for Horticultural Science

GENEVA, N. Y.

PROPOSAL FOR ACCELERATED DISSEMINATION OF SCIENTIFIC KNOWLEDGE

AFTER three years of blockade, which strangled the inflow of scientific literature, the gift of microfilms has been most warmly welcomed by Chinese research-

[1] SCIENCE, August 27, 1943, January 21, 1944, and March 24, 1944.

ers and students. But the fact that it still requires at least 22 days for the information to reach destination (one week for an article to get published in a weekly periodical like SCIENCE, one day to process the microfilm and two weeks to air transport to Kunming) has set the writer thinking of a plan for reducing this time lag to a minimum, which is embodied in the following proposal.

Although the preferred procedure of publishing matters of scientific import is still via the printed journal, the microfilm has already taken over a part of this function, especially in the case of lengthy papers on restricted subjects, where nowadays only an abstract is published and the original microfilmed on application. If photography can effect an earlier appearance of papers of a particular type, the radio, if drafted into service, should revolutionize the circulation of scientific publications of all kinds—be it a short note or a monographic treatise. By radio broadcasting, any scientific information can reach its intended audience the world over in the space of a few hours, certainly not requiring a 22-hour interval. By agreeing on a system of codewords, diagrams, graphs and formulas may be broadcast almost as readily as the text itself, until developments in television should place in our hands facilities not now available. By enlisting the aid of the highest research organizations of the leading United Nations, special stations can be established and maintained for the express purpose of science broadcasting.

For preserving the speeches in permanent form, the system of recording from the loudspeaker, long in use by the radio stations, is admirably adapted to this purpose. The only improvement to be made is the substitution with Cellophane tapes, as recently developed by Fonda, for the familiar discs of resinous composition. While the discs require frequent changes and therefore interruptions, the Cellophane tapes permit continuous recording for eight hours. With this semi-automatic system, the actual recording can be attended to by a trained assistant, and the need of arranging a suitable time to both the sending and receiving stations is entirely obviated. In case an article treats of a highly technical subject, a specialist in the particular field may be called in to take down the playback. From this transcript, mimeographed or printed copies can be made for wider distribution.

From journal articles this practice can be extended to books of considerable length. The royalty problem can be readily solved by reference to precedents established in the other fields of radio broadcasting. If only a digest is broadcast, it may prove a virtual stimulus to the sale of the printed book.

The desirability of accelerated dissemination of scientific knowledge is too well understood to require stressing here, but it may be pointed out that broadcasting would tend to unify the scientific language, itself a potent stabilizer of the peace to come. Having experienced the effect of intellectual isolation, the writer is prompted to bring this proposal to the consideration of the scientists and statesmen of the Allied countries. If it can not conveniently be acted upon during the war, it certainly will be our main concern after the war. We are on the threshold of a new age of contracted space and diminished time and the present suggestion is in keeping with this spirit of the future.

C. L. LIU

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SCIENTIFIC BOOKS

CHIMPANZEES

Chimpanzees. A Laboratory Colony. By ROBERT M. YERKES. xv + 321 pp. Illustrated. Yale University Press. 1943. $5.00.

THIS book is the story of an unusual project in psychobiology. It gives the history of Professor Yerkes's work with chimpanzees over a seventeen-year period and does it in an engaging manner. The book will interest the biologist, the psychologist, the medical man and also the general reader.

Yerkes successfully developed a colony of chimpanzees through controlled breeding and rearing of experimental animals. In the course of the work he faced many practical problems relating to such necessities as feeding, housing, hygiene, health, disease prevention and cure. A considerable body of general information was accumulated about chimpanzee structure and function, instincts, habits and other behavior patterns both in captivity and the native habitats. There are discussions of such topics as emotional traits, social relations, drug addiction and susceptibility, parasitic control and related problems of health. A special chapter is devoted to memory, foresight and insight, and another to language and symbolism. An entire section of the book is concerned with care and handling. An epilogue tells the story of the genesis, development and realization of a research idea. There is a selected bibliography of references. The book is richly illustrated by photographs of apparatus and pictures of animals in a variety of experimental situations. Yerkes is very generous in giving credit to his students and associates for their many contributions.

The reviewer encounters a degree of difficulty in formulating a systematic evaluation of the subjects included in Yerkes's volume, because the diversity of subject-matter does not lend itself to such treatment. However, the bulk of the research is concerned with the behavior endowment of the chimpanzee, and represents a selection from studies originally reported in monograph form.

The choice of any special group of experiments for special mention merely represents the interests of the reviewer. To him, the symbolic behavior described in the chapter on "Language and Symbolism" is of special value because of its close resemblance to the same type of behavior in humans. These experiments deal with the chimpanzees' ability to use tokens in problem solving.

The book is full of useful information for the practical caretaker of the chimpanzee as well as for the research man. It will, in fact, have a wide appeal even for those engaged in other fields. The specialists in the areas treated will find helpful summaries and useful comments on some of their problems. Any one interested in a book on animal life, written primarily from the personal experience of a man who has spent his professional career in the laboratory, will find it both illuminating and entertaining because of its diversity of scientific interests. The general reader will discover much that is both informative and intrinsically interesting in this volume. There are a number of episodes concerning the relations of the chimps with the caretakers and experimenters which indeed make entertaining reading.

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ORGANIC CHEMISTRY

Organic Reactions. Vol. II. ROGER ADAMS, editor-in-chief; WERNER E. BACHMANN, LOUIS F. FIESER, JOHN R. JOHNSON and H. R. SNYDER. Pp. iv + 461. New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd. 1944. Price, $4.50.

IN the October 2, 1942, issue of SCIENCE, p. 319, Vol. I of this series was reviewed and attention called to the announced intention of its editorial board to issue additional volumes from time to time. This volume thus appears in fulfilment of that promise and will receive the same warm welcome accorded its predecessor, for it too will be of great value to all students and investigators in the very extensive field of synthetic organic chemistry.

The ten chapters included, with their authors and number of pages, are as follows: (1) Claisen Rearrangement (48 pp., D. Stanley Tarbell); (2) Preparation of Aliphatic Fluorine Compounds (45 pp., Albert L. Henne); (3) Cannizzaro Reaction (45 pp., T. A. Geissman); (4) Formation of Cyclic Ketones by Intramolecular Acylation (20 pp., William S. Johnson); (5) Reduction with Aluminum Alkoxides (The Meerwein-Ponndorf-Verley Reduction) (64 pp., A. L. Wilds); (6) Preparation of Unsymmetrical Biaryls by the Diazo Reaction and the Nitrosoacetylamine Reaction (46 pp., Werner E. Bachmann and Roger A. Hoffman); (7) Replacement of the Aromatic Primary Amino Group by Hydrogen (38 pp., Nathan Kornblum); (8) Periodic Acid Oxidation (79 pp., Ernest L. Jackson); (9) Resolution of Alcohols (35 pp., A. W. Ingersoll); (10) Preparation of Aromatic Arsonic and Arsinic Acids by the Bart, Bechamp, and Rosenmund Reactions (39 pp., Cliff S. Hamilton and Jack F. Morgan). The same admirable organization of the subject-matter of each chapter is followed as in Vol. I, with tables of contents, detailed lists of compounds to which the particular reaction has been applied and extensive references to the pertinent literature. In format, paper, binding and typography, it likewise resembles Vol. I.

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SPECIAL ARTICLES

ABNORMAL ALPHA KETOSTEROID EXCRETION IN PATIENTS WITH NEOPLASTIC DISEASE*

PREVIOUSLY reported results of studies made in this laboratory of the 17-ketosteroids extracted from individual urine collections of normal persons and those with leukemia, cancer, adrenal dysfunction and pregnancy, have demonstrated the marked variability in the nature and amounts of the substances excreted and have emphasized the importance of securing as full and detailed information as possible concerning the individual components.[1,2,3,4] In these investigations

* The authors gratefully acknowledge the assistance of the Jane Coffin Childs Fund for Medical Research, Commonwealth Fund, Williams-Waterman Fund, New York Foundation, Whiting Foundation, Felix M. and Frieda Schiff Warburg Foundation, Moses Rippa Fund, and Alfred P. Sloan Jr. Research Fund.

[1] K. Dobriner, E. Gordon, C. P. Rhoads, S. Lieberman and L. F. Fieser, SCIENCE, 95: 534, 1942.

[2] C. P. Rhoads, K. Dobriner, E. Gordon, L. F. Fieser and S. Lieberman, *Trans. Assoc. Am. Phys.*, lvii: 203, 1942.

[3] K. Dobriner, third meeting, Conference on metabolic aspects of convalescence including bone and wound healing, Josiah Macy Jr. Foundation, 184, 1943. (Limited distribution).

[4] S. Lieberman, B. R. Hill, L. F. Fieser, K. Dobriner, H. C. Taylor, Jr., and C. P. Rhoads, *Abstracts*, 107th Meeting, Am. Chem. Soc., Cleveland, April, 1944.

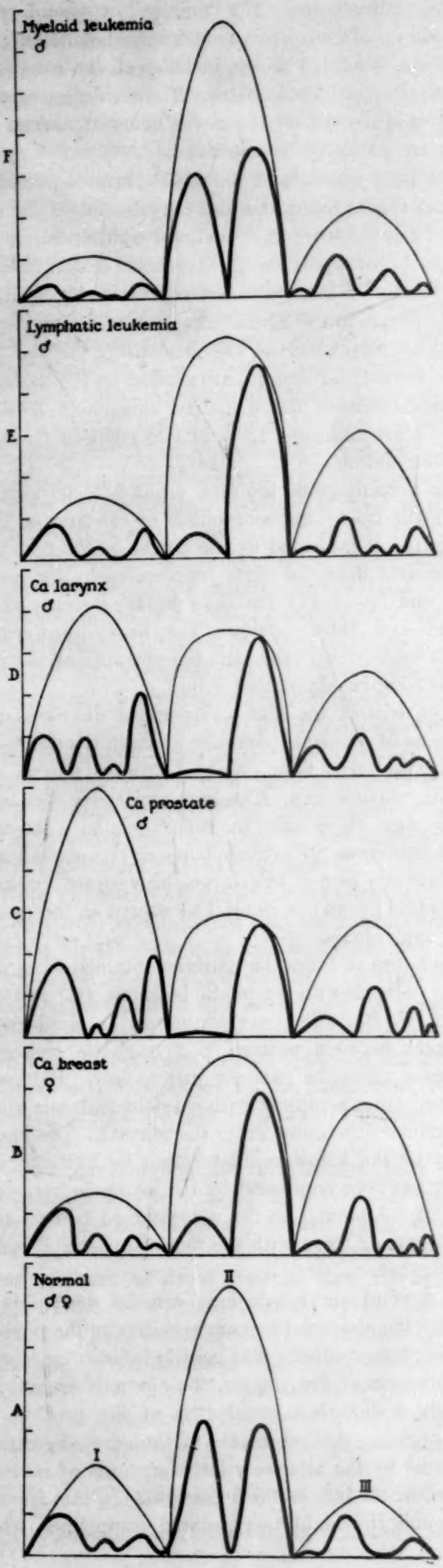
the alpha ketosteroid fraction of each urine has been fractionated systematically by extensive chromatographic adsorption analysis and the various crystalline products encountered have been purified and

TABLE I

Urinary Alpha Ketosteroids

Name or Melting Point of Compound	Formula	Group
248 - 252		
CHLORODEHYDROISOANDROSTERONE	$C_{19}H_{27}OCl$	
* $\Delta^{3,5}$-ANDROSTADIENONE-17	$C_{19}H_{26}O$	
135 - 136		
* Δ^{3}-ANDROSTENONE-17	$C_{19}H_{28}O$	
ALLOPREGNANDIONE-3,20	$C_{21}H_{32}O_2$	
* 117 - 118	$C_{21}H_{32}O_3$	
* 176 - 178	$C_{21}H_{32}O_3$	I
* 132 - 134		
117 - 121		
ALLOPREGNANOL-3α,ONE-20	$C_{21}H_{34}O_2$	
PREGNANOL-3α,ONE-20	$C_{21}H_{34}O_2$	
105 - 108		
120 - 125		
* ANDROSTERONE	$C_{19}H_{30}O_2$	
* AETIOCHOLANOLONE	$C_{19}H_{30}O_2$	II
145 - 148	$C_{21}H_{34}O_2$	
174 - 175	$C_{21}H_{32}O_3$	
* 188 - 189		
235 - 237		
185 - 186	$C_{21}H_{34}O_3$	
199 - 200	$C_{21}H_{32}O_3$	III
195 - 196	$C_{21}H_{34}O_3$	
192 - 194	$C_{21}H_{34}O_3$	
210 - 212	$C_{21}H_{34}O_3$	
230 - 233		
238 - 241		
201 - 204		
172 - 176		

characterized as fully as possible. The apparently homogeneous substances thus far isolated are listed in Table 1 in the order in which they are eluted. They are divided arbitrarily into 3 groups. The "early" or first group, consists of all the compounds which are eluted from an aluminum oxide chromatogram



before androsterone. The "middle," or second group, is made up of androsterone and aetiocholanolone; and the "late," or third group, includes all the compounds eluted after aetiocholanolone. Those substances which are obtained regularly from the urine of normal subjects are indicated by asterisks.

The total amounts of alpha ketosteroids present in each of these groups and also the amounts of the individual components were measured by the Callow procedure based upon the Zimmermann color reaction. The results of the assays are represented graphically by the curves in the figure. The amounts of segregated fractions, expressed as the percentage of the total alpha ketosteroid content, are plotted on the ordinates. On the abscissae the principal substances listed in Table 1 are indicated from left to right in the order of their elution.

The percentage of the total alpha ketosteroid fraction made up by the compounds of the first or early group (I) is indicated by the height of the first peak of the light line; the parts represented by the middle (II) and late (III) fractions by the heights of the second and third peaks. The heavy-lined curves within each group represent the amounts of the individual components of that group.

A pattern of the alpha ketosteroid distribution in the urine of a normal person is given in the figure—A. Similar patterns were obtained from 5 normal men and 5 normal women. The curves resemble each other closely and differ only in minor details. The ratio of androsterone to aetiocholanolone (represented in the patterns as the two large, heavy-lined peaks in the middle group) is about 1:1 except in the case of older individuals.

The figure includes the patterns obtained from individual patients with lymphatic leukemia (E) and cancer (B, C, D). They are abnormal. A similarity is apparent between pattern E (lymphatic leukemia) and those from the patients with cancer. Pattern F obtained from a patient with myeloid leukemia shows only minor differences from the normal. The abnormality of the ketosteroid excretion by patients with cancer has been confirmed by the isolation from their urine of compounds so far not obtained from normal individuals or those with the non-neoplastic disorders investigated.

At present no conclusions can be drawn as to whether the abnormalities are specific for the particular disorders studied. The results indicate an abnormal function of the gonads, the adrenals or both, or possibly a disturbed metabolism of the products of these organs. A dysfunction of the adrenal cortex is suggested by the relatively large amounts of material isolated in the late or third fraction. In this fraction are found the highly oxygenated compounds which are assumed to be metabolites of the adrenal cortical hormones.

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THE NATURE OF MYASTHENIA GRAVIS[1]

IN a recent communication Torda and Wolff[2] reported that the formation of acethylcholine (ACh) from incubated frog brain was significantly reduced in the presence of serum of patients with myasthenia gravis. They concluded from this finding that the defect in ACh synthesis in patients with myasthenia gravis probably explains the fatiguability and weakness of the patients.

A possible correlation between the thymus and myasthenia gravis is suggested by the frequent finding of thymic tumors in these patients. Recently it has been shown by Harvey and co-workers[3] that thymectomy in patients with myasthenia gravis eliminates certain differences between these patients and other individuals in the electro-myographic response to intra-arterial prostigmine injections.

On suggestion of Dr. Otto Loewi the synthesis of ACh from minced brain (after Quastel[4]) has been studied in the presence of thymic tissue obtained from a patient who died from myasthenia gravis and in the presence of serum from patients with myasthenia gravis.

Experiments: In order to be able to run controls from the brain of the same animal, rat brain (because of its larger size) seemed to us more suitable than frog brain. Fresh rat brain was minced in eserine Locke solution and the suspension divided with the pipette into four equal portions. Ground pieces of thymoma tissue were added to half of the samples. One sample with and one without thymoma was extracted immediately with hydrochloric acid, the other two were incubated at 37° and extracted after three hours. The total ACh contents of all the samples were then estimated on the frog rectus muscle.

In an attempt to confirm Torda and Wolff's findings rat brain was also incubated in the manner described above in the presence of serum of six patients with myasthenia gravis and in the presence of serum from

[1] From the Department of Pathology, Columbia University, College of Physicians and Surgeons, New York City.
[2] Torda and Wolff, SCIENCE, 98: 225, 1943.
[3] Harvey, Lilienthal and Talbot, *Jour. Clin. Invest.*, 21: 579, 1942.
[4] Quastel, Teemenbaum and Wheatly, *Biochem. Jour.*, 30: 1668, 1937.

control individuals. The ACh contents were determined before and after incubation. The findings are given in Fig. 1, where it is seen that no significant

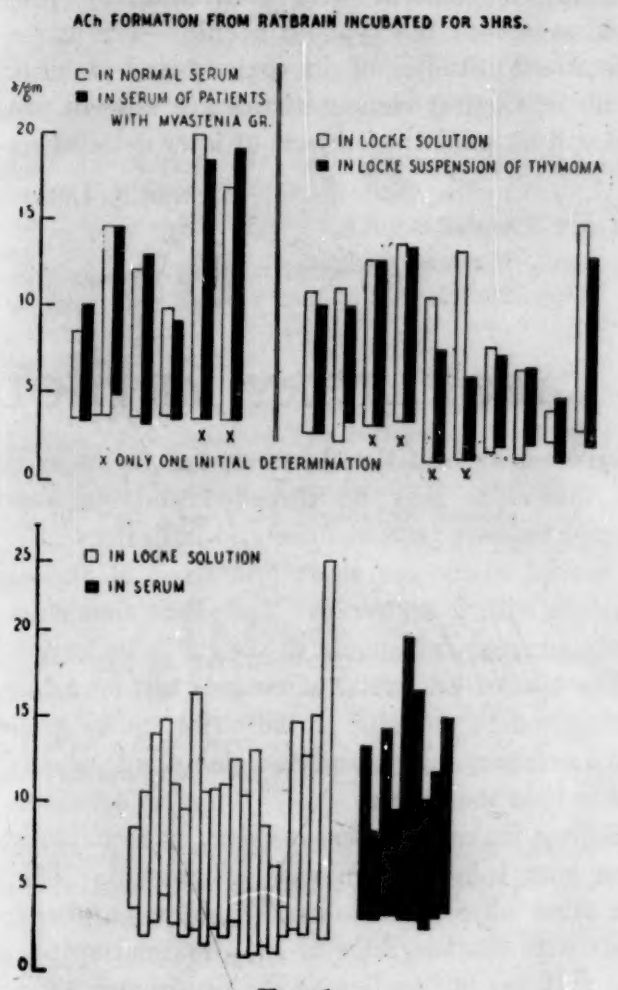

FIG. 1

differences in the amount of synthetized ACh were obtained regardless of whether or not thymus or serum from patients with myasthenia gravis were added to the medium. We also failed to observe significant differences between the amounts of ACh formed in Locke solution and in human serum. The latter findings are in contrast to Torda and Wolff's observations on frog brain.

HERBERT C. STOERK
ELVIRA MORPETH

ANTITYPHOID ACTIVITY OF Vi ANTIGEN FROM EXTRA-GENERIC SOURCES[1]

LONGFELLOW and Luippold[2] reported a high degree of immunity to large doses (10,000 to 1,000,000 MLD) of *E. typhosa* in mice immunized with vaccines prepared from the V-forms of Salmonella which, aside from their content of Vi antigen, were antigenically alien to the typhoid bacillus. Against such large challenging doses, vaccines prepared with the V-forms of *S. ballerup* and *S. coli* 5396/38 produced an immunity in mice against Vi strains of the typhoid organism which was quite as high as that produced by vaccines prepared in an identical manner with Vi strains of *E. typhosa*. It may be added here that the typhoid cultures used in these experiments and in the more recent investigations reported below consisted of pure V-form organisms, having been lyophilized as such and thereby maintained in their most active immunologic and pathogenic state.

It has recently been found that when mice were immunized with serial dilutions of *E. typhosa* and *S. coli* 5396/38 vaccines and subsequently challenged with small "invasive" doses (50 to 1,000 MLD) of typical Vi strains of *E. typhosa,* the *S. coli* 5396/38 vaccine proved to be significantly *more* effective. In short, *S. coli* 5396/38 vaccine produced a higher degree of immunity to *E. typhosa* than did *E. typhosa* vaccine itself. This anomalous result was obtained repeatedly, even when the typhoid vaccine and the challenging organisms were represented by the identical strain of the typhoid bacillus.

It is believed that this superiority of *S. coli* 5396/38 vaccine is a simple quantitative manifestation—that is, a manifestation of a greater quantity of Vi antigen on the V-form *S. coli* 5396/38 organisms than is present on the V-form typhoid bacilli. Some support of this assumption was obtained from dilute-HCl extracts of these two organisms; for, when these extracts, as cleared supernates, were inoculated into mice, there resulted an even greater dominance of *S. coli* 5396/38 over *E. typhosa* in antityphoid immunogenic potency. Just as, organism for organism, *S. coli* 5396/38 vaccine was the more effective, so was the quantity of available Vi antigen on this organism the greater.

In this way, it was found that the immunogen responsible for this immunity was easily removed from the organisms by solution in diluted HCl, from which it could be precipitated with acetone and recovered as a light-brown crystalline powder. Minute amounts of the latter (Vi extract) exhibited marked antityphoid immunogenicity as gauged by the potency of Wakeman's polysaccharide[3] and of Morgan's purified antigen[4].

In comparative mouse-immunization tests with alcohol-insoluble fractions of autolysates (Morgan) or tryptic digests (Wakeman) of the typhoid bacillus, this Vi extract from *S. coli* 5396/38 proved to be more potent per unit of dried material than the typhoid antigens cited above, when opposed by the lower invasive doses (100 to 1,000 MLD) of virulent typhoid organisms. When enormous challenging doses (10,000 to 1,000,000 MLD) of the test organism were given, the antigens prepared from autolysed or digested typhoid bacilli appeared to be somewhat more effective

[1] Preliminary report.
[2] D. Longfellow and G. F. Luippold, *Am. Jour. Hyg.*, 37: 206–210, 1943.
[3] F. B. Wakeman, *Military Surgeon,* 84: 318–338, 452–471, 1939.
[4] H. R. Morgan, *Jour. Immunol.,* 46: 161–180, 1941.

than the Vi extract. The probable interpretation of these results is that the Vi extract possessed the capacity to produce superior anti-invasive immunity, while the typhoid antigens excelled in producing substances which neutralized the toxicity of large doses of bacterial protein—presumably because these typhoid antigens represented more completely the entire typhoid organism.

Although the Vi extract can be prepared from V-form typhoid organisms, the V-form of *S. coli* 5396/38 offers an appreciably more abundant source of this substance which, despite its extra-generic origin, possesses exceptional antityphoid immunogenic properties. Practical application of the use of this Vi extract—specifically as a fortifying agent in bacterial vaccines and in combination with conventionally prepared immunogens of the typhoid bacillus—are under consideration. Studies of its toxicity and stability and of its serological characteristics are now in progress and will be made the subjects of later detailed reports.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN APPARATUS FOR MEASURING THE TORSION ANGLE IN LONG BONES

RECENTLY, in a problem involving measurements of the degree of torsion existing in certain long bones of the extremities, it became necessary to construct a device for making such measurements. Although this torsiometer was devised for use in a particular project, it might also find application in making other anthropometric measurements or in various studies requiring rather exact values for the degree of torsion or twisting of an object. The following is a description of the construction and use of the apparatus.

As shown in Fig. 1, the apparatus consists essentially of a 360° plastic protractor (A) and a pair of pointers (B), attached to a shaft (C) passing through the protractor's center. The protractor and shaft are mounted on a pivot (D) so that the shaft may be swung from side to side if necessary. To permit this swinging the support (E) must be triangular in cross-section, with the apex directed forward. The whole is mounted on a solid level base.

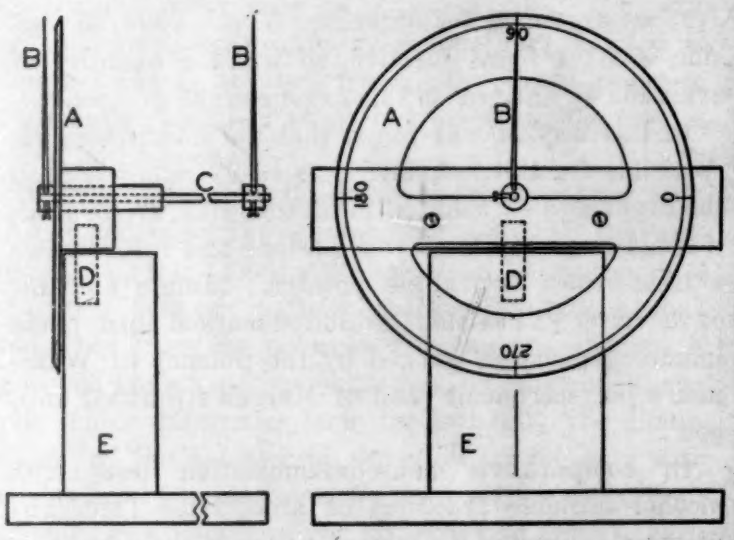

FIG. 1. Diagram of the torsiometer showing side and front views.

Shafts of various lengths may be used, depending upon the length of the object studied, or as in Fig. 1, the indicators may be threaded and screwed into tapped washers; the washers and indicators may then be moved along the shaft and fixed at the desired position with a set screw. The shaft should be perfectly straight and should fit snugly in its bushing.

The size of all parts, of course, will be arbitrarily determined by the size of the object to be studied.

An ordinary ring stand and clamp will usually suffice to hold the object.

Before making a measurement, it is important to have both indicators in exact alignment. The bone (or other object) is clamped rigidly, parallel to the shaft with the long axis of the proximal epiphysis in line with the 90° radius of the protractor. The indicator at the free end of the rod is then turned until it is in line with the long axis of the distal extremity of the bone, and the protractor indicator moves with it. The number of degrees through which the shaft has turned is then read off directly on the protractor.

In cases where the object is not perfectly straight, but is curved to one side or the other, the protractor and shaft may be turned on the pivot until the rear indicator is in alignment with the distal end of the object.

This device has several points to recommend it. The parts are inexpensive and easily obtained. It is easily constructed and readings may be made directly, simply and rapidly.

VERNON E. KRAHL

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BOOKS RECEIVED

NASH, ERNEST. *Roman Towns.* Illustrated. Pp. 201. J. J. Augustin, Publisher. $6.00.

OSBORN, FAIRFIELD. *The Pacific World.* Illustrated. Pp. 218. W. W. Norton and Company. $3.00.

SAWYER, RALPH A. *Experimental Spectroscopy.* Illustrated. Pp. viii + 323. Prentice-Hall, Inc.

SLADEN, FRANK J. *Psychiatry and the War.* Pp. xxii + 505. Charles C Thomas. $5.00.